A GUIDE TO THE CANADIAN WILDLIFE SERVICE NATIONAL REGISTRY OF TOXIC CHEMICAL RESIDUES

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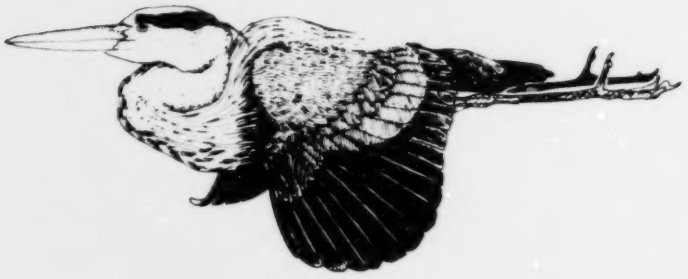

TECHNICAL REPORT SERIES No. 27
Headquarters 1987
Canadian Wildlife Service

Environment Canada
Environnement Canada

Canadian Wildlife Service
Service canadien de la faune

Canada

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CANADIAN WILDLIFE SERVICE

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A GUIDE TO THE

CANADIAN WILDLIFE SERVICE

NATIONAL REGISTRY OF TOXIC CHEMICAL RESIDUES

J.E. Elliott

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Technical Report Series No. 27
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Canadian Wildlife Service

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Environment Canada
National Wildlife Research Centre
Ottawa K1A 0H3

This manuscript is dedicated to the memory of Yves Ouellette whose organizational skills and attention to detail was instrumental in building the National Specimen Bank and the creation of this document.

A Guide to the

Canadian Wildlife Service

National Registry of Toxic Chemical Residues

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ABSTRACT

The computerized National Registry of Toxic Chemical Residues is a repository for information on wildlife specimens analyzed for toxic chemicals by the Canadian Wildlife Service (CWS), or deposited in the CWS National Specimen Bank. Since 1963, residue data for more than 30,000 individual specimens representing 327 species of Canadian wildlife have been added to the data base. Specimens were collected mainly from Canadian territories or near boundary U.S. territories, especially in the Great Lakes. There are also limited data from Canadian migratory species and their prey collected in Central and South America. The registry contains data only from specimens collected in the field and not experimentally dosed. This "User Guide" should help interested persons understand the registry system and assist the user in obtaining both data on residue levels in wildlife and information on the contents of the CWS National Specimen Bank. First, the Guide reviews the data base contents. This is followed by a brief technical description of the internal data organization and the processes involved in data capture and retrieval. Data release policies and requirements are then outlined. Details on how to make use of and interpret the data output constitute the main part of the manual. The Appendices contain further information on how to submit and request data, a list of species in the registry with a summary of data ranges and locations.

ABREGE

Le Registre national automatisé des résidus de produits chimiques toxiques est un répertoire d'informations sur les spécimens fauniques analysés par le Service canadien de la faune (SCF) pour déceler la présence de produits chimique toxiques ou sur ceux ayant été déposés dans la banque nationale de tissus du SCF. Depuis 1963, cette base de données a été enrichie de données sur les résidus recueillies après analyse de plus de 30,000 spécimens de 327 espèces fauniques du Canada. Ces spécimens ont été recueillis principalement en territoire canadien ou dans les régions proches de la frontière américaine, particulièrement celle des Grands lacs. Ce registre contient également une quantité limitée de données sur des espèces migratrices canadiennes et des spécimens de leurs proies relevés en Amérique centrale et en Amérique du Sud. Il ne contient que des données sur des spécimens pris dans leur milieu naturel et non sur des spécimens ayant été mis en contact avec certaines doses de produits chimiques toxiques dans le cadre d'expériences de laboratoire. Ce "Guide de l'usager" devrait aider les personnes intéressées à comprendre le système sur lequel le registre est basé et ses usagers à obtenir des données sur les quantités de résidus présents dans la faune ainsi que des informations sur le contenu de la banque nationale de tissus. Il contient premièrement une description du contenu de la base de données. Vient ensuite une brève description d'ordre technique de l'organisation interne des données et de leur mode de saisie et d'extraction. Ceci est suivi de renseignements sur la politique et les exigences auxquelles il est nécessaire de satisfaire pour la diffusion des données. Les instructions sur le mode d'utilisation et l'interprétation des données constituent la majeure partie de ce manuel. Les annexes contiennent des informations supplémentaires sur la soumission et les demandes de données ainsi qu'une liste des espèces figurant dans le registre et un résumé indiquant les périodes couvertes par les enquêtes et relevés et les régions où ils ont été effectués.

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We wish to thank Vanda Cuccaro for typing, editing, and suggesting changes to the manuscript. Helpful suggestions were made by Pat Angehrn, Chip Weseloh, John Struger, and Daniel Carrière. And special thanks to those individuals too numerous to mention who have contributed to Canadian Wildlife Service pesticide and toxic chemical studies over the years.

1. Introduction

The National Registry of Toxic Chemical Residues, referred to as the "Registry", is operated by the Toxic Substances Evaluation and Monitoring Division (TSEMD) of the Canadian Wildlife Service. It provides a national service to CWS and other government or private organizations involved in measuring the levels and/or investigating the effects of environmental contaminants.

The Registry was established in 1964 following the recommendations of a federal-provincial conference (1) which identified the need for a central repository for registration of information on pesticide residues in wildlife. By 1968, a data management system had been defined and a data entry program was written to permit information to be stored on magnetic tape files. Some general maintenance programs were produced by 1972 which allowed restricted retrieval of data. By 1978, the system had become increasingly limited and the need for a more powerful,flexible system was recognized. In 1980, the Scientific Information Retrieval, or SIR, data base management system was introduced (2) and the Registry data transferred into a SIR file. To that point, Registry data were restricted to analyzed specimens. The decision was made in 1981 to include in the registry, data from unanalyzed specimens which are stored in the CWS National Specimen Bank.

The CWS National Specimen Bank is a collection of wildlife samples, preserved by deep freezing, for possible future analysis. Details regarding the specimen bank, together with the procedures for requesting samples, can be found in the complementary publication, "A Guide to the Canadian Wildlife Service National Specimen Bank" (in preparation)

2. Contents of the National Registry of Toxic Chemical Residues

The data in the Registry come primarily from CWS investigations of threats to wildlife by toxic chemicals. Although there are data on various organic contaminants, such as dioxins, chemical analysis has been focused on the organochlorine (OC) pesticides, PCBs and mercury. There are also data on levels of trace elements, particularly lead and cadmium. While the data include a variety of species, the emphasis has been on migratory birds as CWS has a specific mandate to investigate and protect this group. A brief review of CWS activities is available (3) as is a more detailed review of earlier CWS work (4).

Appendix C contains a list of all species for which there are data in the Registry up to 1984, together with the collection years, the province of collection, the class of compounds analyzed and a reference to CWS publications which make use of the data.

More detailed information on data in the Registry can be obtained from the National Registry of Toxic Chemical Residues Catalogue Series, which is a listing of data organized by species, tissue, year, province and number of analyses for each chemical. The series is available in five regional volumes:

1. Atlantic Region - Newfoundland, P.E.I., Nova Scotia, and New Brunswick
2. Quebec Region
3. Ontario Region
4. Western Region - Manitoba, Saskatchewan, Alberta and Northwest Territories
5. Pacific and Yukon Region - British Columbia and Yukon Territory

Requests for copies of these catalogues should be addressed to:

Head Laboratory Services
National Wildlife Research Centre
Canadian Wildlife Service
Environment Canada
Ottawa, Ontario
K1A 0H3 Ph. 819-997-1410

3. A Brief Technical Description of the National Registry of Toxic Chemical Residues

3.1 Data Structure and Organization

Most ecotoxicological work is done at the individual organism level, whether it involves the measurement of a given chemical residue or an associated toxicological response. Hence, the key element in the National Registry of Toxic Chemical Residues is the discrete field collected specimen. Each new specimen is sequentially assigned a unique "USOX Number". USOX stands for "Unit Source of X", were X refers to any specimen analyzed for toxic chemicals or archived in the National Specimen Bank by CWS. Each specimen is then treated as a separate case in the data base. Exceptions to this approach occur for pooled samples, where a number of individuals collected at one point in time and space are processed and analyzed together e.g. 5 Barn Swallow eggs for which only one analysis is to be performed would be pooled together. The pool is then assigned a single USOX number and treated as a separate case.

The data associated with each specimen are organized in a hierarchy as depicted in Figure 1. Field collection and tissue processing information and any comments are included once. However, each specimen may "own" any number of tissues such as liver, kidney, fat, etc., which are removed for real time analysis and/or storage in the National Specimen Bank. Each tissue may be further subsampled in order to meet various analysis requirements. Thus, each tissue then owns a number of subsamples. Finally, each subsample may be analyzed for one or more chemicals.

3.2 Data Collection Procedures

The preparation and analysis of samples for toxic chemical residues and the management of associated data occur at the National Wildlife Research Centre (NWRC). This serves to standardize methods, reduce costs and facilitate the operation of the Registry and Specimen Bank. Activities are coordinated at the national level by the Wildlife Toxicology Subcommittee (WTS), a group of CWS regional and headquarters biologists and research scientists who meet to review project proposals for the forthcoming year.

The process of data capture for the Registry is described in Figure 2. Details regarding each source of information - field data (records 1,2,3), analytical data (records 4,5,6) and Specimen Bank data (records 7,8) are described below.

Data capture proceeds as follows:

1. Standard forms are completed by data submitters.

2. The data are coded and input into a microcomputer project file at NWRC.

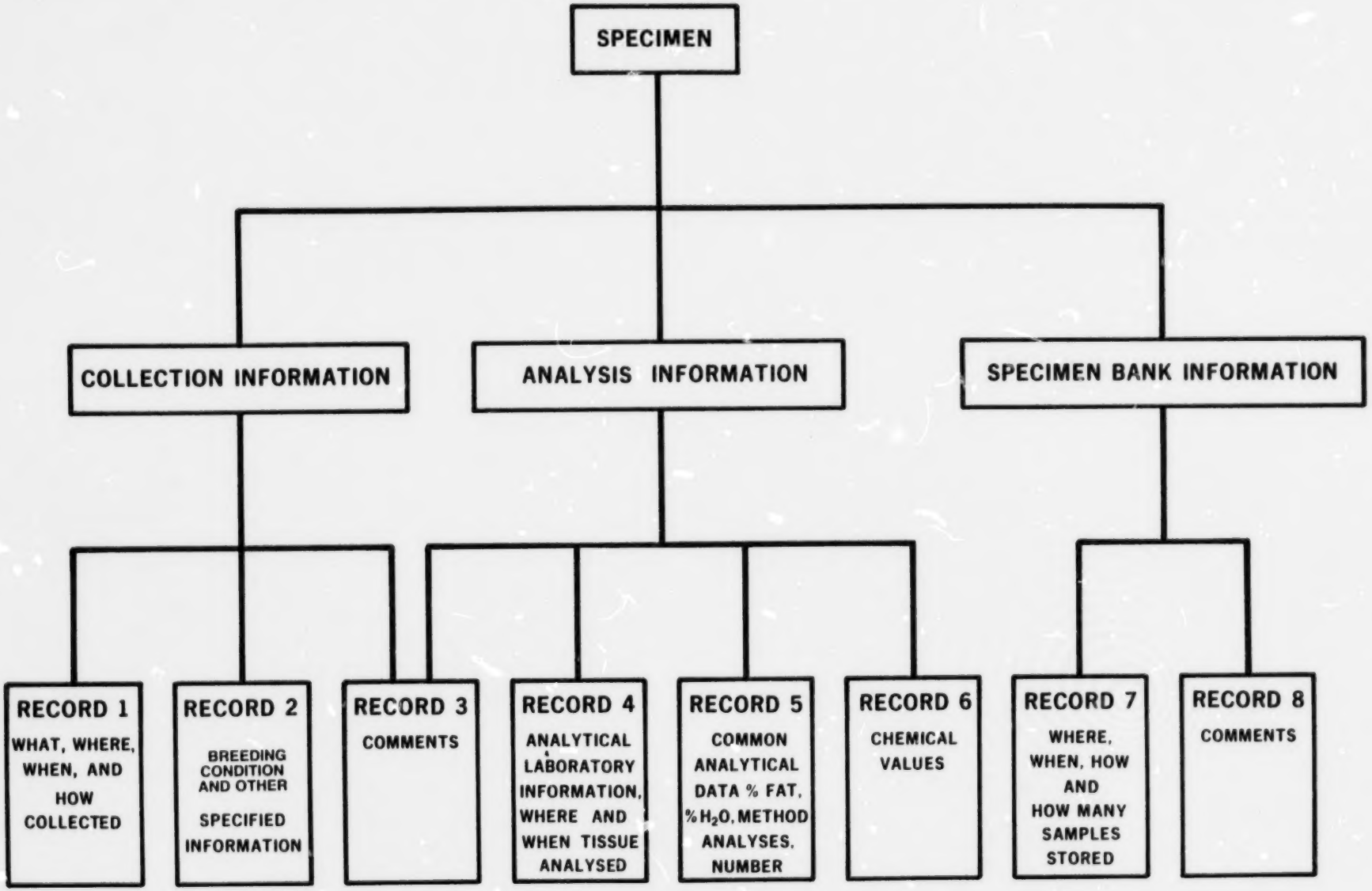

Figure 1 National Registry of Toxic Chemical Residues Logical Data Structure

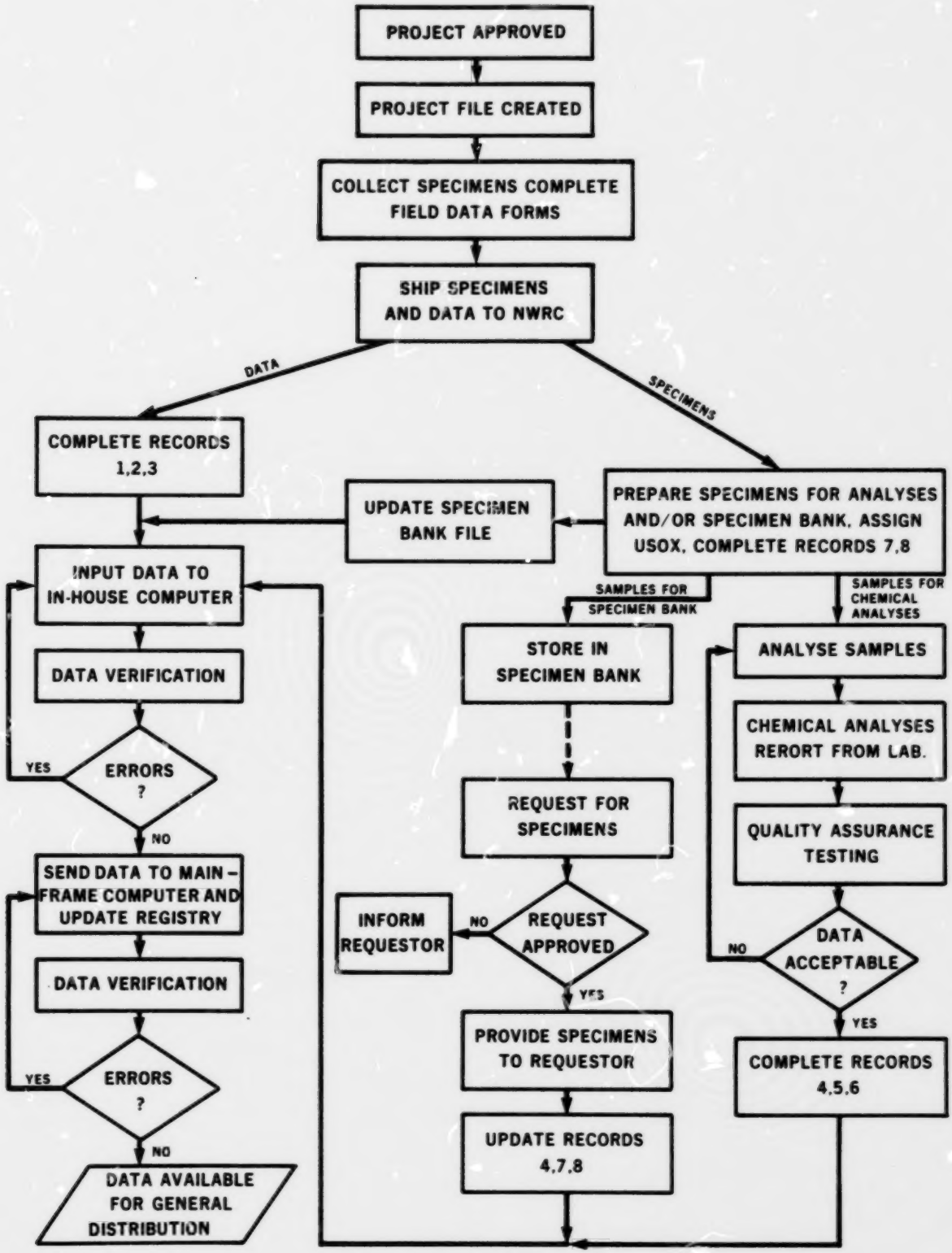

Figure 2 National Registry of Toxic Chemical Residues – Data Flow and Storage Block Diagram

3. Data are transferred from the microcomputer into mainframe computer SIR files.

3.2.1 Field Data

Sample collection is carried out primarily by qualified CWS personnel or by professional consultants under contract to CWS. Collection by other government agencies or private individuals is also done under "piggy back" arrangements, designed to minimize the costs especially in remote locations. For example, collection of arctic wildlife is often conducted for CWS by scientists with the National Museums of Canada or the Department of Indian and Northern Affairs. Polar bears or other big game mammals are generally collected from hunter's bags in co-operation with provincial wildlife officials. Fur-bearing mammals can be obtained through co-operation with trappers.

Standard procedures are always enforced to reduce contamination or spoilage of specimens. These protocols are available in the CWS internal document, "Collecting and Shipping Wildlife Specimens for Chemical Analysis" (Appendix D) .

Detailed instructions for completing and submitting field data forms are in Appendix A (Figure 3 is an example of a completed field data sheet). These forms are normally completed by the collecting biologist or technician and must be provided with the samples or no analysis or specimen banking will be done. While field data, such as map coordinates and species identification, are verified by Registry technicians, the submitter must be relied upon for accuracy.

3.2.2 Specimen Bank Data

The records include data on methodology used to prepare the sample for analysis, details regarding how the specimen was aliquoted and stored in the Specimen Bank and the number, type and size of containers used.

Most specimens are simultaneously prepared for analysis and archiving in the Specimen Bank. This approach minimizes the number of times a specimen must be frozen and thawed for subsequent re-analysis.

Standard procedures are adhered to as closely as possible during dissection and other preparation of specimens. Choice of materials and cleaning methods for containers, instruments and work surfaces is standardized. This information has been described briefly (3) and the details are documented in internal operating manuals.

Sample preparation data are recorded in laboratory notebooks which then serve as original documentation. The Specimen Bank Technologist then codes the notebook data for input to project files.

Environment Canada Wildlife Service | Environnement Canada Service de la Faune

NATIONAL REGISTRY OF TOXIC CHEMICAL RESIDUES
BUREAU NATIONAL D'INSCRIPTION DÉS RÉSIDUS CHIMIQUES TOXIQUES

DO NOT FILL IN SHADED AREA
NE RIEN ECRIRE DANS LA CASE OMBREE

PROJECT / PROJET: Contaminants Monitoring in Raptors

COLLECTION FORM NO. / FORMULE DE PRELEVEMENT N°:

COLLECTOR / ECHANTILLONNEUR: Jane Smith

SUBMITTOR / EMETTEUR: John Doe

COLLECTING ORGANIZATION / ORGANISATION CHARGEE DU PRELEVEMENT: CWS

Index	Laboratory Number / Laboratoire n°	Specimen Number / Echantillon n°	Units in Specimen / Unités dans l'échantillon	Tissue or Part / Tissu or partie	Species / Espèce	Category / Catégorie d'Age: Age Class	Sex / Sexe	Collection Date / Date du prélèvement	Collection Site - Emplacement du prélèvement: Lat. Deg.	Lat. Min.	Long. Deg.	Long. Min.	Location / Endroit	Province	Collecting Technique / Technique de prélèvement	Condition when Collected / Etat lors du prélèvement	Storage Location / Emplacement d'entreposage
		1	1	egg	Gyrfalcon	2	4	1 July '75	68	29	137	05	North Rapid Creek	Yukon	taken from nest	Fresh	
		2	4	egg contents				20 July '75								embryonated	
		3	1	egg												addled	
		4		whole body	Peregrine Falcon	3	1	12 Aug. '75	64	07	083	28	Southhampton Is. (19 m W Corral Hbr.)	NWT		Fresh	
		A			Horned Lark	14	4	15 Aug. '75							shot		
		B				3									taken from nest		
		C			Lapland Longspur												
		D			Snow Bunting												

STORAGE TECHNIQUE / TECHNIQUE D'ENTREPOSAGE: Frozen

STORAGE CONTAINER / RECIPIENT D'ENTREPOSAGE: Aluminum Foil

LABORATORY STORAGE TECHNIQUE / TECHNIQUE D'ENTROPOSAGE POUR LE LABORATOIRE:

LABORATORY STORAGE CONTAINER / RECIPIENT D'ENTROPOSAGE POUR LE LABORATOIRE:

Figure 3: An Example of a Completed Field Data Sheet

Figure 3 con't.

SOME EXPLANATORY NOTES FOR CWS TOXIC CHEMICALS COLLECTION FORM

All columns should be filled where possible

COLLECTING ORGANIZATION
- Organization for whom collector is working, e.g., Alberta Department of Lands and Forests

SPECIMEN NO.
- To consist of no more than six digits and/or letters. No Roman Numerals please.

UNITS IN SPECIMEN
- The number of items included under one specimen number, e.g., "3" for a clutch of three eggs, "10" for ten tadpoles.

AGE
- In years, months, weeks, and/or days, if known.

AGE CLASS
- As outlined in the explanatory pamphlet.

COLLECTION DATE
Use only this format: 21 Oct 70.

COLLECTION SITE - LOCATION
- Distance and direction from a town or other point that can be located on a map. If Latitude and Longitude are not known, please give sufficient detail to locate the collection point to the nearest ½ mile. This allows us to determine the collection site to the nearest one minute block. The topographic map name and number may also be included here.

COLLECTING TECHNIQUE
- E.g., shooting

CONDITION WHEN COLLECTED
- E.g., fresh, emaciated

REMARKS
- Any other pertinent data such as sex, weight, symptoms of disease or poisoning, abnormalities, etc. Please feel free to expand this section at the bottom of the sheet, on the reverse side, or on a separate sheet.

STORAGE - TECHNIQUE
- E.g., formalin, frozen

- CONTAINER
- E.g., glass, aluminum foil

Note: Where the same data apply to a series of specimens, use ditto marks or vertical continuation arrows.

QUELQUES NOTES EXPLICATIVES SUR LES RESIDUS CHIMIQUES TOXIQUES PRÉLEVÉS PAR LA SCF

Remplir toutes les colonnes si possible

ORGANISATION CHARGÉE DU PRÉLÈVEMENT
- Organisation pour laquelle l'échantillonneur travaille. Par exemple, le ministère des Terres et forêts de l'Alberta.

Nº DE L'ÉCHANTILLON
- Ne doit pas être composé de plus de six chiffres et/ou lettres. Prière de ne pas se servir de chiffres romains.

UNITÉS DANS L'ÉCHANTILLON
- Le nombre d'éléments que l'on retrouve dans un échantillon. Par exemple, "3" pour une couvée de trois oeufs, "10" pour dix têtards.

ÂGE
- L'inscrire, si possible, en années, en semaines et/ou en jours.

CATÉGORIE D'ÂGE
- Tel que souligné dans la brochure explicative.

DATE DU PRÉLÈVEMENT
- N'utiliser que cette formule: 21 Oct. 70

EMPLACEMENT DU PRÉLÈVEMENT – ENDROIT
- Distance entre l'emplacement et une ville proche ou tout autre point pouvant être localisé sur la carte (position géographique de l'emplacement par rapport à cette ville). Si la latitude et la longitude sont indéterminées, veuillez fournir les renseignements nécessaires permettant de reconnaître l'emplacement du prélèvement à un demi-mille près. Le nom et le numéro de la carte topographique peuvent être inscrits sous cette rubrique.

TECHNIQUE DE PRÉLÈVEMENT
- Par exemple, le tir.

ÉTAT LORS DU PRÉLÈVEMENT
- Par exemple, frais, décharné.

REMARQUES
- Ajouter toutes autres données pertinentes telles que la grosseur, le poids, les symptômes d'une maladie ou d'un empoisonnement, anomalies etc. Si nécessaire compléter cette section au bas de la feuille, à son verso, ou sur une feuille détachée.

ENTREPOSAGE - TECHNIQUE
- Par exemple, utilisation de la formaline, de la réfrigération.

- RÉCIPIENT
- Par exemple, en verre, en papier métallisé.

Note: Lorsque les mêmes données s'appliquent à plusieurs échantillons, inscrire "idem" ou tracer une flèche verticale et continuer à remplir les autres cases.

Specimen Number / Echantillon nº	Breeding Condition / Condition de repr.	Age: Years / Années	Age: Months / Mois	Age: Weeks / Semaines	Age: Days / Jours	Age: Hours / Heures	Ecological Location / Milieu	Egg Measurements / Mesure d'oeuf: Length / Long	Width / Largeur	Thickness / Épaisseur	Weight / Poids	Remarks / Remarques

3.2.3 Analytical Data

This includes relevant information on the actual chemical analysis of samples and the results of the analyses.

Chemical analysis for Registry data is done in-house at NWRC or by contract laboratory. In each case, the analyst is provided with a homogenized aliquot suitable in size for the type of analysis to be performed. Samples are shipped to contract laboratories according to standard procedures which involve packing in styrofoam coolers with dry ice.

Chemical analysis is conducted using strict quality control procedures which are written into all contracts for analytical services. CWS can refuse to accept and pay for any analyses which do not meet quality control standards. The use of standard reference materials is fundamental to chemical analysis. A procedure for testing the accuracy of an analysis is to include blind numbered reference vials with the samples being analyzed. Reference materials for organic materials are prepared in-house at NWRC. Working reference pools include a large composite of Great Lakes Herring Gull eggs (5) and a smaller batch of Polar Bear liver. National Bureau of Standards (NBS) reference materials such as bovine liver and oyster tissue are used for inorganic analysis.

Analytical data are always provided by the chemist in a formal report. Once the data have passed the quality control tests, they are coded and input to the project file.

3.2.4 Comments and Miscellaneous Information

Comments may be included from the submitter concerning the circumstances of collection, from the processing technician concerning the state of the specimen or from the analyzing chemist concerning unusual analytical circumstances or observations. Record 3 is also used to reference data from other tests which may have been performed on the specimen, such as histological or biochemical assays for the effects of contaminants. These other data are stored in the project's hard-copy file. Data input of this type would originate from the Specimen Bank and Registry Biologist. The comments are recorded and entered into the microcomputer's project file along with other data.

3.2.5 Data Verification and Editing

Data are checked at each transfer step as indicated in Figure 2. Older data are continually being verified as they are used. This verification process includes detailed checking of each data item against original hard copy records. In general, the incidence of random errors attributable to coding, data punching or other sources, is less than 0.1 percent.

3.3 Data Retrieval Procedures

Approved requests for data are passed from the Support Services Supervisor to the Data Services Technologist who examines the request to determine the type of data required and the most efficient means of accessing it. Many requests are for specific background data or analysis results. These can be easily provided by photocopying or summarizing relevant field collection sheets or analytical reports. General information, concerning for instance the number of Ring-billed Gull samples on file from Alberta 1976, can be readily obtained from Record 1 (collection data) or in-house microcomputer files. Requests for Specimen Bank data can be processed in a similar fashion.

Larger requests for data requiring chemical analysis results involve accessing the whole computer data base. If the request is for a standard output format, it can be done interactively via remote terminal at NWRC. Requests requiring non-standard outputs are normally undertaken by programmers from Environment Canada's Systems and Informatics Directorate (SID).

4. Data Release Procedure and Policy

4.1 Data Request Procedure

Requests for data from the Registry should be directed to:

Head, Laboratory Services
National Wildlife Research Centre
Canadian Wildlife Service
Environment Canada
Ottawa, Ontario
K1A 0H3

Requests should be in the form of a "National Registry of Toxic Chemical Residues, Data Request Form". Appendix B contains a copy of this form along with the instructions for completing it. No charge will be made. Approximately one month should be allowed for delivery.

The output will be limited to one copy of the requested data on standard 11.5 x 14 computer paper. It will be in the form of a regular detailed printout as depicted in Figure 4. The basic report is available in the following five variations. The most suitable format will be provided according to the information provided on the Data Request Form:

Report 1 - Record types 1 to 6 inclusive
- This is a detailed retrieval of all data for a specimen except for Specimen Bank information.

Figure 4: An Example of the Standard Registry Output

DATE 17/09/84 NRTCR PAGE
USOX 2011

CHARADRIIFORMES 67
ALCIDAE 010
ALCA TORDA 0002
RAZORBILL
COLLECTION NUMBER 88-001
001 SPECIMENS IN UNIT

AGECLASS	ADULT	SEX	**********
COLLECTOR	LEARNING W.J.	COLLECTING ORG.	CAN. WILD. SERVICE
COLLECTION DATE	JANUARY 2 /88	PROVINCE	NEWFOUNDLAND
COLLECTING LOC.	10 KM SE GREAT I		
LAT.	DEG. 47 MIN. 11		
LONG.	DEG. 52 MIN. 49		
COLLECTING TECH.	SHOT	CONDITION COLLECT.	FRESH
STORAGE TECHNIQUE	FROZEN	STORAGE CONTAINER	ALUMINUM FOIL
BREEDING CONDITION	*	AGE: YR ** MO ** WK ** DY ** HR **	
ECOLOGI. LOCATION	*****		
EGG WEIGHT	***	EGG WIDTH	***
EGG LENGTH	***	EGG THICKNESS	****

COMMENTS: BIRD WAS CONTAMINATED WITH OIL

LABORATORY	ONT. RES. FOUNDATION	CHEMIST	DR. L.M. REYNOLDS
ANALYSIS DATE	22/08/88	REPORT #	8804
TISSUE	BREAST MUSCLE		

METHOD 52 REPLI. 1 BASIS WET %FAT 2.3 %WATER 87.2
ANALYSIS # 148 CWS # *********

CHEMICAL	LIMIT	CONCENTRATION	CONCENTRATION +
P,P' -DDT		0.025	.
DDE	ND	0.0005	.
OXYCHLORDANE	ND	0.0005	.
MIREX	ND	0.0005	.
PCB(1:1)		1.22	.
HCB	<	0.005	.
HG		0.19	.

Report 2 - Record types 1 and 3 to 6 inclusive

- Includes all data except for breeding and Specimen Bank data

Report SB1 - Record types 1 to 8 inclusive

- Includes all data for a specimen

Report SB2 - Record types 1 and 3 to 8 inclusive

- Includes all data except for breeding information

Report SB3 - Record types 1,3,4,7,8

- Includes only specimen collection data, comments and Specimen Bank data

4.2 Data Release Policy

Registry data are available to individuals or organizations requiring information on toxic chemical residues in Canadian wildlife. Requests are subjected to a preliminary review to determine:

1: Is the request complete?
2: Is there adequate justification?
3: Is the requestor qualified to analyze and interpret the data?
4: Has the requestor complied with these rules in the past?
5: Is written consent from the original submitter necessary? (based on reviewer's knowledge of the data base and the purpose to which the data will be used.)
6: Is a special printing program required? If yes, can it be completed in the required time?

The preliminary review includes a "quick look at the raw data" to determine if problems exists with the data or to resolve the request immediately i.e. no data exist. Work will not progress until such problems are resolved.

When the request has been approved in principal data will be released unless it is "on hold", pending publication by the original submitter. Data on hold will only be released to a third party on the written permission of the submitter.

Release of Registry data is also subject to four other provisions. By signing the Data Request Form, the requestor agrees to:

1. use the data only for the purpose indicated in the original justification;

2. permit CWS scientists to review any papers using Registry data prior to publication;

3. acknowledge the original submitter of the data and the Registry as sources of data in any such publications;

4. provide free of charge at least two reprints of any such publications, and one each for the original submitter.

CWS also encourages the requestor to seek expert advice from CWS personnel regarding interpretation of Registry data . The original submitter of the data should be contacted to advise on collection criteria and/or analysis criteria, etc.. CWS, thus strongly encourages co-operative investigations resulting in joint publication of results.

5. Use of the Data Output

5.1 Data Report Format

Each item in a typical Registry standard output (Figure 4) is described below in approximate descending order, beginning with Record 1 through to Record 8. Asterisks are used to indicate missing data. Specimen Bank data will be produced on an alternate form (Figure 5) when such data is requested.

The report begins with the date the computer retrieval was completed, the heading and the page number for the given retrieval.

Record 1

This information is as provided by the submitter, except for the USOX number which is assigned at NWRC and the collecting location which may be modified by NWRC technicians using more detailed maps.

USOX - A master number assigned sequentially to each specimen as it enters the Registry system.

Taxonomic Information - The first three lines after the date on the top left of the sheet identify the specimen in scientific nomenclature, normally to the species level. A three-tiered hierarchy is used:

Order
Family
Genus and Species

To the right of each of the taxa is their corresponding code used by the NRTCR.
The taxonomy is determined according to the following standard references:

Birds - Canadian Wildlife Service, 1964 (6)

Mammals - Hill, 1965 (7)

Fish - Bailey et al., 1970 (8)

Herptiles - Cook, 1980 (9)
Collins et al., 1982 (10)

The common English name is listed opposite the scientific name, under the USOX number.

Figure 5: An Example of Specimen Bank Data Output

```
DATE  17/09/84                                  NRTCR                    PAGE
                                                      USOX   20111

CHARADRIIFORMES                  67              RAZORBILL
    ALCIDAE                       010            COLLECTION NUMBER 88-001
       ALCA TORDA                  0002          001 SPECIMENS IN UNIT
AGECLASS              ADULT                     SEX                **********
COLLECTOR             LEARNING W.J.             COLLECTING ORG.    CAN. WILD. SERVICE
COLLECTION DATE       JANUARY  2 /88            PROVINCE           NEWFOUNDLAND
COLLECTING LOC.       10 KM SE GREAT I
              LAT.    DEG.   47 MIN. 11
              LONG.   DEG.   52 MIN. 49
COLLECTING TECH.      SHOT
STORAGE TECHNIQUE     FROZEN                    CONDITION COLLECT. FRESH
                                                STORAGE CONTAINER  ALUMINUM FOIL

BREEDING CONDITION    *                   AGE: YR **  MO **  WK **  DY **  HR **
ECOLOGI. LOCATION     *****
EGG WEIGHT             ***                EGG WIDTH           ***
EGG LENGTH             ***                EGG THICKNESS       ****

COMMENTS: BIRD WAS CONTAMINATED WITH OIL


DATA SHEET #  593

TISSUE        STORAGE          WEIGHT  QUANTITY    STOR.    PROCES.   LAB   PROJ.
  STATE       CONTAINER          (G)   ORG  REM    LOCAT.     DATE    BOOK   NO.

LIVER
  HOMOGEN.    GL VIAL TFL        6.5    2    2     S1D203  15/07/88   A54   8804
  HOMOGEN.    POLYETH VIAL       6.5    1    1     S1D203  15/07/88   A54   8804

KIDNEY
  NOT HOMO.   GL VIAL TFL        7.2    1    1     S1D203  15/07/88   A54   8804

BREAST MUSCLE
  HOMOGEN.    GL VIAL TFL        6.5    4    3     S1D203  15/07/88   A54   8804
  HOMOGEN.    GL JAR TFL        25.0    1    1     S1D203  15/07/88   A54   8804
```

Collection Number - This is the sample identification number used by the submitter.

Specimens in Unit - In the case of pooled samples, the number of individual specimens which constitute the pool.

Age Class - The estimated age of the specimen may be provided. Normally designated as egg, nestling, hatching year, immature, second year, third year, adult.

Sex - Male, female, mixed (for pools), or unknown are the only options.

Collector - Either the scientist(s) supervising a project or the technician(s), contractor(s) or other persons collecting for the project leader may be listed.

Collecting Org. (Collecting Organization) - This is normally CWS.

Collection Date - The date on which the specimen was collected in the field.

Province - This refers normally to the Canadian province in which the specimen was collected. For data from the U.S., state is used; for samples outside North America, country of origin is used.

Collecting Loc. (Collecting Location) - Whenever possible, a name is given to the specific site of collection. While discrete sampling situations, such as colonial bird breeding sites or small islands are easily described, many collection sites are not, such as wilderness raptor nests, trapping locations etc. This field is limited to a length of 19 characters, therefore abbreviations may be used or the last word may be truncated.

Lat. and Long. (Latitude and Longitude) - NWRC technicians determine map co-ordinates to the degree minute using the largest scale maps available (generally 1:50,000) and working from a detailed description of sample site provided by the submitter.

Collecting Tech. (Collecting Technique) - The specific means by which the specimen was obtained in the field. The most common methods are: by hand (for eggs especially), trapping (live/dead), shooting, netting, found dead (e.g. road kills).

Condition Collect. (Condition When Collected) - The following categories are most widely used: fresh, dead-no information, dead-information available, addled (for eggs), regurgitation. The majority of specimens included in the Registry were collected fresh in order to avoid possible post-mortem changes in residue levels. Dead specimens have also been collected for investigating reproductive failure

or to obtain adult samples of rare or hard to collect species available from road kills, hunters or trappers.

Storage Technique - The method of preservation and/or storage used in the field and prior to shipment to NWRC (at which point all samples are placed into -25 C temporary storage).Normal field methods are: frozen, formalin, alcohol, room temperature, incubator, freeze-dried, hard-boiled, dry ice, and liquid nitrogen.

Storage Container - The container used in the field and for shipping and temporary storage prior to processing. The containers used for long-term storage are listed under Record 7. Standard field container materials are: polyethylene, aluminum foil, glass, Teflon[R].

Record 2

This record was designed specifically for breeding data on birds, although some of the fields can be used to include similar information for other taxonomic classes. Note: most specimens in the registry do not include this information.

Breeding Condition - The reproductive state of the specimen at the time of collection. The most widely used terms are: breeding or non-breeding male or female, gravid female, incubating female, male tending nestling, etc.

Age - At the time of collection; provision is made for year, month, week, day, hour.

Ecologi. Location (Ecological Location) - To date, this field has not been used. It will be used to classify the basic ecology of the collection site.

Egg Weight - Recorded in grams to one decimal place for cleaned eggs which are warmed above the dew point to prevent water condensate that contributes to weight.

Egg Width - Recorded in centimetres to two decimal places using calipers on the clean intact egg at the widest point.

Egg Length - Recorded in centimetres to two decimal places on the clean intact egg.

Egg Thickness - Recorded in millmetres to three decimal places using a micrometer or modified dial caliper. Eggshells are rinsed and then dried for at least two weeks prior to thickness measurement.

Record 3

Comments - This record may contain information of the following sort:

1. Written comments made by the collector dealing with the condition of the specimen at the time of collection (such as state of health) or about the circumstances surrounding the collection.
2. Written comment by the analyzing chemist concerning the conditions at time of analysis or peculiarities in the results.
3. References to other tests which may have been performed on the specimen such as pathological examination, histological or biochemical analyses designed to assay for possible effects of toxic chemical residues.

Record 4

Common Laboratory Data

Laboratory - Name of the laboratory where analyses are performed.

Chemist - Generally the chemist supervising the laboratory.

Analysis Date - Date the particular analysis was performed.

Report # - The number assigned by the laboratory to the report submitted to CWS containing the particular data.

Tissue - The specific tissue or combination of tissues analyzed. The tissues most commonly analyzed by CWS for various toxic chemicals are: egg, kidney, fat, whole body, brain, liver, muscle and bone. These general tissue types may be further specified, such as: liver-left lobe, fat-mesentery, whole body minus skin and feathers, breast muscle, bone-left femur, etc.

Further details describing the tissue may be found in Record 7.

Record 5

Common Analytical Data

Method - The specific chemical analysis procedure that was used. Detailed descriptions of methods must be supplied by the analyzing chemist. These methods are assigned codes and filed for reference purposes.

Replicate - A number of analyses may be performed on the same sample (specimen and tissue). If so, each analysis is numbered sequentially and the number listed here.

Basis - The weight basis used to calculate the concentration of the chemical. Wet, dry, and fat (or lipid) weight are the standard choices.

Results can be readily converted from one weight basis to another. As an example, consider the results in the sample printout in Figure 4. The PCB level is 1.22 ppm on a wet weight basis. In order to convert to a lipid weight basis, consider that at 1.22 ppm (wet weight) there are 1.22 micrograms of PCB in 1 gram of wet tissue. The tissue contains 2.3% lipid, therefore there are 1.22 micrograms of PCB per 0.023 grams of lipid. Thus, the concentration is 1.22/0.023 or 53.04 ppm (micrograms/gram) on a lipid weight basis.

Similarly, to convert to a dry weight basis, again consider that there are 1.22 micrograms of PCB per gram of wet tissue. The tissue is 87.2% water and 12.8% dry matter. Therefore, there is 1.22/0.128 or 9.53 ppm of PCB on a dry weight basis.

Analysis # - The number assigned, by the analytical laboratory, sequentially to each analysis included in a given report.

CWS # - A number which may be assigned to a sample at NWRC, separate from the USOX number.

Record 6

Chemical Analysis Results

Chemical - The chemicals reported for a given sample are listed according to their Registry code. These codes have been assigned sequentially as new chemicals are added to the system. Pesticides are referred to by name as listed in the Nanogen Index (11). Metabolites are referred to by the common name in general use in the scientific literature.

The PCBs (polychlorinated biphenyls) are complex mixtures of isomers which pose difficulties both in the analysis and reporting of results. PCBs found in Canadian wildlife have generally been described as resembling two common commercial mixtures, referred to as Aroclor 1260 or Aroclor 1254, both of which are trade names of Monsanto Corporation (12). PCBs in the Registry are therefore reported as PCB "1260", if the pattern of peaks resembles this mixture, or alternatively as PCB "1:1-1254:1260" if the pattern indicated a basically equal combination of the two. Designations such as PCB "8:6-1254:1260", would indicate a preponderance of one mixture.

Trace elements are reported as the total element measured and are referred to by their standard English name.

Organic-metal complexes are referred to by the common name, such as methyl-mercury.

Limit - Any limitation of the analysis result for the given chemical. Possible codes are ND - non-detectable, < - less than, NC - not calculated, and OLD - old data. ND, <, and NC are described below. An OLD code indicates data entered before this coding system was developed. To determine any limitations of these data, one must return to the original analysis report. The absence of a code indicates no limitation.

Concentration - This is the residue level in parts per million or micrograms per gram as provided by the analytical laboratory. Although most analysis results are reported to just three significant figures, the field contains seven places and a decimal point.

Before 1972, chemicals which were not detected in a sample are listed in the Registry with a value of 0.0. After 1972, a value was entered into the Registry only when the laboratory provided a numeric result. However, this includes values that are reported as less (<) than a certain value. In these cases half the "less than" value is entered into the data base. For chemicals reported as non-detectable (ND), a value of half the detection limit is entered.

Detection limits vary according to the tissue and the method of analysis. However, generally the detection limit for OC pesticides prior to 1982 was < 0.001. Since 1982, a value of < 0.005 is generally used. The detection limit for PCBs is generally < 0.01.

For chemicals reported as NC (instances where a small peak is observed on the chromatogram but it cannot be calculated because of an interfering peak), no value is entered.

Concentration ± - This field permits data to be modified, as improvements in analytical methodology allow the application of correction factors to earlier data. For example, until 1976, a vacuum drying step was employed during sample preparation for OC analysis. It was later discovered that this step caused losses of some of the more volatile OC compounds, specifically HCB, DDT, DDD and oxychlordane. Re-analysis of samples from the Specimen Bank and comparison of results with and without this step enabled determination of standard factors by which the old data in question could be multiplied to arrive at a more accurate value. These factors are incorporated into the Registry for pertinent data. Both the "old" (concentration) and the "new" (concentration +) value are provided. The latter should be used.

Record 7

Specimen Bank Data

This record, which is present only for specimens for which there are tissues stored in the CWS National Specimen Bank, includes basic information on which tissues are stored, the quantities of each and the type and number of storage containers. Further data on the tissue processing methods and references to hard copy documentation are also included (Figure 5 is an example of the present printout of Records 7 and 8).

Tissue - Generally the tissue type will be as in Record 4 of the analytical data. However, further details may be included for Specimen Bank purposes.

Tissue State - The condition of the tissue at the time of storage: homogenized, not homogenized, freeze-dried and unknown (for some older samples) are used.

Storage Container - Old tissue bank samples may be stored in a variety of container types. New samples are stored only in the following containers: polyethylene whirlpak bag, plastic bottle, glass vial with foil liner, linear polyethylene vial, Teflon vial, Teflon jar, polyethylene jar, glass vial with Teflon liner, polyethylene bag.

Weight - The weight in grams of sample material in the indicated container.

Org. Quantity (Original Quantity) - The original number of the indicated type of container.

Rem. Quantity (Remaining Quantity) - The number of the indicated type of containers remaining in the National Specimen Bank.

Stor. Locat. (Storage Location) - The physical location in the National Specimen Bank freezers.

Proces. Date (Processing Date) - The date the specimen or sample was processed.

Lab. Book - The laboratory notebook containing the information recorded at time of dissection and processing.

Proj. No. (Project Number) - Most new specimens are part of a particular CWS project. Common information can be accessed through the project number, including a description of the methodology used to dissect and prepare a specimen for chemical analysis. These descriptions are kept quite general; full details can be found in the laboratory notebook.

Data Sheet # - The field collection data sheet for the specimen.

Record 8

Specimen Bank Comments

This field contains comments about the specimen recorded at the time of processing, which may be relevant to analysis or long-term storage.

5.2 Interpretation of Data

CWS personnel are available to assist requestors in interpreting Registry data. CWS also encourages co-operation between its scientists and other interested parties in the interpretation and publication of the data.

Although the requestor must outline the intended use for Registry data (in the justification section of the request form), data are normally released for one of the following reasons:

1. The data are required to assess whether exposure to environmental contamination may have had an effect on health of individuals or of a population of a wildlife species.

2. The data are required to assess whether consumption of wildlife may result in exposure of human consumers to elevated levels of contamination.

3. The data are required to use wildlife samples as indicators of contamination of an ecosystem by toxic chemicals.

The analysis and interpretation of the data will vary according to which of the above objectives is being pursued. However, no interpretation of chemical residues in wildlife should be attempted without some knowledge of the pertinent biology of the wildlife species. Information should be assembled on feeding ecology, as the diet is normally the main source of toxic chemicals. Movement and/or home range of the species may also indicate the source of contamination.

Interpretation, especially for Objective 3 type studies, should include an understanding of the environmental chemistry of the chemicals of concern, information on use and sources of input to the environment and characteristics such as persistence and bioaccumulation potential. Finally, reference should be made, particularly for type 1 studies, to information on interactions between the chemicals and the biota, including toxicology and any other biological effects.

Interpretation of Registry data should also consider the following:

1. The samples provided from the Registry are not necessarily random, representative samples from a population or geographic region. Inference from the sample to the population should only be attempted where there are sufficient data on collection procedures to indicate that efforts have been made to collect a random sample. This may involve contacting the original collector to obtain information on the sampling design.

2. The chemical analysis results, especially for pre-1979 data, must be interpreted with care (see Section 5.1, Record 6). The likelihood of encountering gross transcription errors is low; however, if such errors are suspected, then CWS Registry operators should be notified for verification. The possibility of systematic analytical error must also be considered. Pre-1979 data should not be used without reference to the chemical analysis methodology. This is particularly important with regard to pre-1970 OC data, as values for many OC pesticides may be distorted by the presence of PCBs in samples (12). Re-analysis of many Registry specimens is made possible by storage of tissues in the CWS National Specimen Bank.

6. References Cited

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APPENDIX A

How to Submit Collection (Field) Data

General Information

All samples sent to NWRC for chemical analysis or Specimen Bank storage must be accompanied by National Registry of Toxic Chemical Residues Field Collection Form. Before submitting samples, the collector should verify with the Specimen Bank and Registry Biologist that they will be accepted. Samples arriving at NWRC without Collection Forms will be placed in holding freezers (unlocked at -20 C with no temperature monitoring or emergency power supply) until the data are provided. This prevents accumulation of miscellaneous undocumented specimens in CWS freezers.

The Collection Form (Figure 3) is two-sided. Side 1 contains the what, where, when and how information as well as areas for use by NWRC. Side 2 contains some instruction material as well as detailed egg information, egg measurement fields, and remarks.

Side 1 should be completed by the collector/submitter, with the information on side 2 optional. However, it is desirable that side 2 be completed where applicable.

Completion Instructions

Project - General description of the project for which the samples were collected. This is usually the name used when submitting the project for approval to the WTS.

Collector - Enter the name of the person who actually did the collecting or was responsible for the collection.

Submitter - Enter the name of the person responsible for the project, who may also be the collector. For instance, John Doe, who initiated the project, is the submitter while Jane Smith did the collection and sent in the samples.

Collecting Organization - This is the organization responsible for the project, or with which the submitter is associated. This may serve as a reference should the submitter not be available.

Specimen Number - This is a number assigned by the collector that should be limited to six characters. Samples submitted to NWRC are given a unique NWRC number (USOX) to avoid duplication of numbers from different collectors.

Units in Specimen - This field refers to the number of individuals reported under the one specimen number. Thus, if 10 shrimp are submitted under one specimen number, the units in specimen is 10. However, if the 10 shrimp are given individual specimen numbers, then the units in specimen is 1.

Tissue - Enter a description of the tissue being submitted, e.g., whole body, brain, egg, liver, etc.

Species - Enter the common and scientific name of the sample using two lines if necessary. While the scientific name clarifies the species, the common name permits the data to be used by those not familiar with scientific nomenclature.

Age Class - This is a general description of the age of the specimen using standards as described by the American Ornithologists' Union (AOU) as well as the terms adult and juvenile.

Sex - If the sex of the specimen is known, it should be recorded as some chemical residue levels may be correlated with the sex of the animal.

Collection Date - The collection date should be as precise as possible. Data will be accepted only if at least the month and year are recorded.

Collection Site - If the latitude and longitude are known, complete these fields, along with a general description of the location, e.g., 49 18 lat., 122 53 long., Port Moody, Thermal Plant. The province field also applies to state and/or country.

Collecting Technique - This field should describe the method used to collect the sample, e.g., by hand, by gill-net, by poisoning with _____ (state agent).

Condition When Collected - This refers to the condition of the sample at the time of collection, e.g., alive, dead, addled, fresh (may refer to an egg), etc.

Storage Technique - This refers to the method of storing the sample after collection, e.g., frozen, freeze-dried, formalin, etc.

Storage Container - This refers to the container(s) used to store the sample after collection, e.g., chemically clean glass, aluminum foil, acid-cleaned glass/plastic, etc.

Breeding Condition - This refers to the breeding status of the sample, if known, according to AOU standards.

Age - This refers to the actual age of the specimen, if known, recorded as the smallest known time span.

Biological Location - A more detailed description of the collection site. This field is at present not used due to a lack of standards to describe collection sites.

Egg Measurements - This should be completed if data available.

APPENDIX B

Instructions for Completing the Data Request Form

The data request form should be completed using the Registry output and a copy of the data description. The form is designed to provide the National Registry of Toxic Chemical Residues and the Specimen Bank Biologist with the information necessary to determine:

1. What data are required and for what reasons?
2. Should the data be released by the Registry?
3. A work schedule for accessing data.

Once a request is approved, permission to release data may be required from the collector, if the data are on hold. This responsibility may be passed on to the requestor if numerous collections are involved.

Completion of Form

Request date: the date the request was completed or mailed.

Required by: the date by which the data are required. The requestor should consider that it often requires 1 week for mail delivery, 1 week to access the request, 1 week for response and time to process the computer work and obtain collectors' permission. Thus a realistic "required date" would be 4 to 6 weeks.

Requested by: Please complete in full including phone number. Phone calls are necessary to make sure the correct information is provided.

Required data: The three boxes give the main data groupings and provide standard data outputs. Please elaborate in the space provided if other formats or data are required. It is important that all items requested be listed, the method of reporting (i.e. paper output or computer disk etc.) and the type or priority of the sort be indicated and if a non-standard report form is requested, a rough copy of the desired table is necessary.

Output format: Usually as illustrated in Figure 4. If another format is preferred exact details of the type and structure of the output are necessary.

Justification: Although all areas of the report are important, this field determines whether the data will be released from the Registry and whether the (TSEMD) will support the requestor's bid for information from the collector.

This section should clearly explain how the data will be used. Although the Registry information is not classified as confidential, it is in the best interest of CWS and Environment Canada to see that the use and interpretation of the data is reliable and reflects all information known about the collection, storage and analysis methods. It is CWS policy to safeguard the collector and the public by ensuring that data are published properly and not out of context.

NATIONAL REGISTRY OF TOXIC CHEMICAL RESIDUES
DATA REQUEST FORM

Request Date: _____ (da/mo/yr) Required By: _____ (da/mo/yr)

Requested By:

Name	
Agency	
Address	
Phone	Postal Code

Required Data: ☐ collection ☐ analytical ☐ specimen bank

Using the space provided below, outline details of the exact data required. Include the following information: species, tissue(s), collection date range, location, chemicals of concern.
(Attach additional sheet if required)

Output Format: ☐ standard ☐ specialized (describe below)

Justification: outline briefly for what purpose data is to be used.
(Attach details on separate sheet)

Agreement: I agree to abide by all CWS rules and regulations as described in Section 4.2 of the NRTCR User's Guide with regard to use of data.

Signature: _____ Date: _____

APPENDIX C

A Listing of Species for Which There are Data in the National Registry of Toxic Chemical Residues, Their Collection Years, Province of Collection, the Class of Compounds Analyzed, and a Reference to CWS Publications Which Make Use of the Data.

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Blue Mussel	67-69			*	*						*					OC HG	9,16,25,45
Freshwater Clam	69,72				*											OC HG PCB	9
Soft-shelled Clam	69				*											HG	9,25,45
Crayfish	71						*	*								OC HG	20,24
Lake Sturgeon	66						*									OC	
American Eel	69				*											HG	9,45
Alewife	69,71				*		*									OC HG PCB	9,25,45
Atlantic Herring	68,69,74				*	*										OC HG PCB	9,45
Cisco	69,71						*									OC HG PCB	15
Lake Whitefish	69,70						*									OC HG PCB	15
Bloater	74					*										OC HG PCB	
Blackfin Cisco	23,24,69						*									OC HG PCB	15
Mountain Whitefish	68										*					HG	9,45
Rainbow Trout	65,68,69						*				*					OC HG	9,45
Atlantic Salmon	67				*											OC	4
Brown Trout	66	*														OC OP	
Arctic Char	72												*			OC PCB	35
Brook Trout	67-70,73,74				*	*				*						OC PCB OP	4
Lake Trout	66,68-70						*		*		*					OC HG	9,45,46
Capelin	68	*														OC	
Rainbow Smelt	71						*									OC HG PCB	
Mud Minnow	73						*									HG PCB	
Northern Pike	21-24,67-70,75					*	*	*	*							OC HG PCB	9,15,16,45,46
Northern Lampfish	69														*	OC PCB	
Blue Lanternfish	69														*	OC PCB	
Pataka	71														*	OC HG PCB OP	34
Shreeba	71														*	OC HG PCB OP	34
Utah Chub	73						*									OC PCB	
Peamouth	68										*					HG	9,45
River Chub	67				*											OC	4
Golden Shiner	67				*											OC	4

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Common Loon	68,70-76		*	*	*	*		*	*	*						HG OC PCB	31,45,47,55,58,59,63
Yellow-billed Loon	69											*				OC PCB	31
Arctic Loon	69-71								*	*		*				OC PCB HG	31
Red-throated Loon	67,69,71			*	*				*			*				OC PCB HG	31
Red-necked Grebe	68,69,71,72,81,82,83				*		*	*	*	*						OC PCB HG	9,31
Horned Grebe	68-71				*	*		*	*							OC PCB HG	8,31
Eared Grebe	68,69,71,82,83							*	*							OC PCB HG	8,31
Western Grebe	68,69,71,72,82,83						*	*	*	*						OC PCB HG PB TE	8,13,17,31
Fulmar	71,75,76	*										*				OC PCB	
Sooty Shearwater	70									*						OC PCB HG	31
Bermuda Petrel	74-79														*	OC PCB HG	
Leach's Storm-Petrel	68,70-72,76,80	*			*	*				*						OC PCB HG	17,31,59,62
White Pelican	68-70						*	*	*	*						OC PCB HG	8,13,17,31
Brown Booby	71						*									OC PCB HG	
Gannet	67-70,72-74,76	*			*	*	*				*					OC PCB HG	17,25,31
Double-crested Cormorant	68-73,75,76,79,81		*	*	*	*	*	*	*	*	*					OC PCB HG	8,9,12,13,15,17,25,31,48,55,57-59,62,66,74
Pelagic Cormorant	68,70										*					OC PCB HG	9,31,57-59
Great Blue Heron	68-70,72,73,77-79,82			*	*	*	*			*	*					OC PCB HG	8,9,12,13,17,23,31,47,59
Little Blue Heron	71														*	OC PCB	34
Cattle Egret	71														*	OC PCB HG	34
Common Egret	71														*	OC PCB HG	34
Snowy Egret	71														*	OC PCB HG	34
Black-crowned Night Heron	68-73,75-78,82				*	*			*	*				*	*	OC PCB HG	8,31,34,41,55,66
Trumpeter Swan	76									*						OC PCB HG	
Canada Goose	67-71,76	*			*	*			*	*	*					OC OP HG	8,13,45
Snow Goose	68-70					*	*				*	*				OC HG PCB	45
Mallard	65,68-71,76,78,81,82,83					*	*	*	*	*	*	*				OC HG PCB PB TE	7,8,12,13,21,22,24,44,45,47,59
Black Duck	67-71,75,76	*	*	*	*	*	*									OC HG PCB	9,44,45
Gadwall	64,65,68-70								*	*						OC HG	1,8,13
Pintail	64-66,68-71						*	*	*	*	*	*				OC HG PCB OP	1,8,21,45,47,59
Green-winged Teal	68,70,71,74,76	*	*	*	*	*	*	*	*	*	*	*				OC HG PB TE	44,45
Blue-winged Teal	64,65,68,70,71,75		*		*	*	*		*	*						OC HG	1,8,22,24,44,45
European Widgeon	68									*						OC HG	
American Widgeon	64,65,68,70,71,74,81,82						*		*	*	*	*				OC HG PB TE	1,8,24

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Common Shiner	82				*											OC HG PCB PB TE	
Blacknose Shiner	82				*											OC HG PCB PB TE	
Spotfin Shiner	82				*											OC HG PCB PB TE	
Sand Shiner	82				*											OC HG PCB PB TE	
Northern Squawfish	68										*					OC	4
Longnose Dace	67			*												OC	4
Fallfish	67,82				*											OC HG PCB PB TE	9,45
Longnose Sucker	69,82				*	*										OC HG PCB	9,15,45
White Sucker	67,69,70			*	*	*										OC HG PCB OP	4,9,15,45,46
Brown Bullhead	82				*											OC HG PCB PB TE	
Noja	71													*		OC HG PCB OP	34
Kwie-kwie	71													*		OC HG PCB OP	34
Burbot	69,70					*		*								OC HG PCB	15,45,46
Atlantic Tomcod	69			*												HG	9,45
Pacific Saury	69													*		OC PCB	
Banded Killifish	82				*											OC HG PCB PB TE	
Atlantic Silverside	68,74			*										*		OC HG PCB	
Brook Stickleback	69				*											HG	9
Threespine Stickleback	67			*												OC OP	4
White Bass	69					*										HG	9,45
Rock Bass	69,70,72					*										OC HG PCB	9,45,46
Pumpkinseed	69,72,82				*	*										OC HG PCB PB TE	9
Bluegill	66,73				*	*										OC HG PCB	
Smallmouth Bass	68,71,72			*	*	*										OC PCB	
Rainbow Darter	66				*											OC	
Yellow Perch	22-24,66,68-70,72,74, 75,77,82			*	*	*										OC HG PCB OP PB TE	9,15,24,45
Sauger	67				*	*										OC HG	9,45
Walleye	24,69,70,72				*	*										OC HG PCB	9,15,45,46
Mozambique Mouthbrooder	71													*		OC HG PCB O'	34
Krobia	71													*		OC HG PCB OP	34
Atlantic Mackerel	67,68,74	*			*											OC HG PCB	25
Copper Rockfish	68										*					OC HG	9,45
Lingcod	68										*					HG	9,45
Cabezon	68				*											OC	
Lumpfish	68	*														OC OP	
Winter Flounder	69			*												HG	9,25,45

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Shoveler	65,67,70,74						*	*	*			*				OC HG PB TE	6,21
Wood Duck	67,68,70			*	*					*						OC HG OP	9,44
Redhead	70,76				*	*			*							OC HG	44,45
Ring-necked Duck	70,71	*		*	*	*										OC HG	44
Canvasback	69,70					*		*	*	*						OC HG PB PCB	21,45
Greater Scaup	67,68,70,71,76,77			*	*	*	*				*					OC HG PB PCB TE	6,44,45
Lesser Scaup	64,68-71,76		*	*	*	*		*	*							OC HG PCB OP	1,8,13,21,44,45
Common Goldeneye	67,68,70-72,75,76	*	*	*	*	*	*									OC HG PCB	9,22,24,44,45,47
Barrow's Goldeneye	82									*						OC HG PCB PB TE	
Bufflehead	69,70,81,82								*	*						OC HG PCB PB TE	21
Oldsquaw	68,71,76				*					*		*				OC HG	45
Common Eider	67,69,70,72	*		*	*											OC HG PCB	31,62
King Eider	76											*				OC PCB	
White-winged Scoter	71				*											HG	
Surf Scoter	68,70,71,76,77				*					*						OC HG PB TE PCB	45
Common Scoter	68,76				*					*						OC HG	45
Hooded Merganser	71,76				*	*										HG	22,24,45
Common Merganser	69-72,75,76,82	*	*	*	*	*		*	*							OC HG PCB PB TE	21,22,24,44,45,47,59
Red-breasted Merganser	63,69-72,76,82	*	*	*	*	*			*							OC HG PCB	9,45,59
Turkey Vulture	70					*										OC HG	47
Black Vulture	71													*		OC HG PCB	34
Goshawk	69			*												OC	31
Sharp-shinned Hawk	68,83			*				*								OC HG PCB	7,17
Cooper's Hawk	67-71,73,75,78				*		*	*	*	*						OC HG PCB	7,17,31
Red-tailed Hawk	67-70					*	*	*	*	*						OC HG PCB	7,17,31
Red-shouldered Hawk	73					*										OC HG PCB	36
Swainson's Hawk	67-71,73							*	*							OC HG PCB	7,17,31
Rough-legged Hawk	66-68,72-74,80,81				*						*	*				OC HG PCB	
Ferruginous Hawk	68,69,71							*	*							OC HG PCB	7,17
Golden Eagle	68,69,72-75							*	*		*	*				OC HG PCB	7,17,31
Bald Eagle	68-74	*		*		*	*	*		*						OC HG PCB OP	15,17,31,32,47
Marsh Hawk	67-69				*		*	*	*	*						OC HG PCB	7,17,31
Snail Kite	71													*		OC HG PCB	34
Osprey	69-75	*				*			*	*	*		*			OC HG PCB OP	31
Gyrfalcon	69,71,73-76,80,81								*	*	*	*				OC HG PCB	31
Prairie Falcon	67-78,80							*	*							OC HG PCB	3,7,17,26,31,40,66
Peregrine Falcon	65-82	*		*	*			*	*	*	*	*	*			OC HG PCB OP	5,17,31,38,66

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Merlin	68-78				*			*	*	*	*	*				OC HG PCB	7,17,26,31,40,60
Kestrel	67,68,82		*					*	*	*						OC HG PCB	7,17
Spruce Grouse	69			*												OC	
Ruffed Grouse	64,66-69			*					*							OC	
Willow Ptarmigan	67,76						*						*			OC TE	6
Sharp-tailed Grouse	68,69,71						*	*								OC HG	7,26
California Quail	64,65									*						OC	
Ring-necked Pheasant	64,65,68-70,72,73		*			*		*	*	*				*		OC HG PCB	7,53
Hungarian Partridge	64,65,67-70		*			*	*	*	*							OC HG PCB	7
Sora	69									*						OC PCB	
Purple Gallinule	71													*		OC PCB HG	34
American Coot	65,68,69	*						*	*	*						OC PCB HG	8
Wattled Jacana	71													*		OC PCB	34
American Oystercatcher	82													*		OC HG PCB PB TE	
Black Oystercatcher	71									*						OC PCB HG	
Semipalmated Plover	67,68,81				*	*	*		*				*			OC HG	6,17
Killdeer	68,81								*	*						OC HG	17
American Golden Plover	81													*		OC PCB	
Two-banded Plover	81													*		OC PCB	
American Woodcock	59-61,63,64,69-78,80		*	*	*	*										OC HG PCB OP	10,11,17,18,28,43
Common Snipe	66,67,70,71,75	*	*	*		*	*	*		*			*			OC HG PCB	17
Long-billed Curlew	69								*							OC PCB	17,43
Whimbrel	64								*							OC	
Spotted Sandpiper	68,70-72,83			*	*				*	*						OC HG PCB PB TE	14,43,59
Willet	69								*							OC PCB	17,43
Lesser Yellowlegs	67,71						*							*		OC PCB HG	6,17,34
Pectoral Sandpiper	68												*			OC PCB	
White-rumped Sandpiper	81,82												*	*		OC PCB HG PB TE	
Baird's Sandpiper	81,82												*	*		OC PCB HG PB TE	
Least Sandpiper	67,71												*	*		OC PCB	34
Dunlin	67,68,70,82									*			*			OC PCB HG	17,43
Semipalmated Sandpiper	67,68,81				*								*			OC	
Marbled Godwit	68,69								*							OC PCB	17
Hudsonian Godwit	81													*		OC PCB	
Sanderling	70,82					*								*		OC PCB OP HG PB TE	
Hudsonian Curlew	82													*		OC HG PCB PB TE	
American Avocet	68								*							OC HG	8,13

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Wilson's Phalarope	67							*								OC	
Northern Phalarope	67				*		*					*				OC HG	6,17
Iceland Gull	72				*											OC HG PCB	
Glaucous-winged Gull	67,68,70,77,82									*						OC HG PCB PB TE	9,31,57,58,59
Great Black-backed Gull	71						*									OC	
Western Gull	68									*						OC	9
Herring Gull	65-83	*	*	*	*	*	*	*	*	*	*		*	*	*	OC HG PB PCB TE	8,13,17,24,25,29,31,33,38,39, 41,47,49-58,61,64,65,67-73
California Gull	66,68,69,73,77						*	*	*	*						OC HGB PCB	8,12,13,17,31
Ring-billed Gull	65-73,76-79	*	*		*	*	*	*	*	*	*					OC HGB PCB PB TE	8,13,25,31,33,41
Black-headed Gull	72														*	OC PCB	53
Franklin's Gull	66,68							*	*							OC HG	8,13
Bonaparte's Gull	65,67,68						*	*			*					OC	6,9
Little Gull	71												*			OC HG PCB	
Ivory Gull	76												*			OC PCB	
Black-legged Kittiwake	76												*			OC PCB	
Ross' Gull	76,78												*			OC PCB HG	
Common Tern	68-76,79		*	*	*	*	*	*	*	*				*		OC PCB HG	8,9,12,13,17,19,25,30,31,37, 41,42,47,57-59,62
Arctic Tern	67,77						*							*		OC PCB HG	6
Sooty Tern	72													*		OC PCB	
Least Tern	74													*		OC PCB	
Caspian Tern	66,69,71,72,76,80,81					*	*									OC PCB HG	31,41
Razorbill	70,72,73,78	*			*											OC PCB HG	31,62
Common Murre	68,70,71	*			*					*						OC PCB HG	17,25,31,62
Thick-billed Murre	67,75-77				*							*				OC PCB	31
Dovekie	68	*														OC	17
Black Guillemot	67,70,73,82	*			*							*				OC HG PCB	31,62
Pigeon Guillemot	70									*						OC HG PCB	31,59
Marbled Murrelet	68,69,81,82									*						OC HG PCB PB TE	9,17,31
Ancient Murrelet	68,69,71,72									*						OC HG PCB	17,31,43
Cassin's Auklet	70,71									*						OC HG PCB	31,43
Rhinoceros Auklet	69,70									*						OC HG PCB PB	17,31,59
Common Puffin	68,70-73,76,80	*			*	*										OC HG PCB	17,25,31,43,62
Tufted Puffin	70									*						OC HG PCB	31,59
Band-tailed Pigeon	71								*							OC	
Domestic Pigeon	68-71,76,77,81,82				*	*		*	*	*						OC HG PCB	7,43

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Mourning Dove	68,82							*	*	*						OC HG PCB	7
Great Horned Owl	67-70			*		*			*	*			*			OC HG PCB	7,17,31
Snowy Owl	73												*			OC HG PCB	
Burrowing Owl	68								*	*						OC HG	7,17
Long-eared Owl	67-69								*							OC HG PCB	17,31
Short-eared Owl	67-69								*	*	*					OC PCB	7,17,31
Common Nighthawk	68									*						OC	
Belted Kingfisher	66-68,70,75,78		*	*	*	*				*						OC HG PB TE PCB	9
Yellow-shafted Flicker	73,81				*	*										OC HG OP	
Yellow-bellied Sapsucker	64,67-69,77		*	*		*										OC	2
Eastern Kingbird	64,68,81			*		*			*	*						OC HG	
Western Kingbird	68									*						OC	
Least Flycatcher	64,66			*	*											OC HG	
Olive-sided Flycatcher	64,73			*												OC OP	
Horned Lark	67-71,81	*			*				*	*			*			OC HG PCB	7,26
Tree Swallow	75,78			*						*						OC HG PCB OP	75
Bank Swallow	67,81			*		*										OC HG	
Barn Swallow	64,74,75			*												OC OP	
Cliff Swallow	66-68									*			*			OC HG PCB	43
Purple Martin	73			*												OC OP	
Blue Jay	64,74			*												OC	
Black-billed Magpie	70								*							OC PCB	
Common Raven	70,76					*							*			OC HG	47
Common Crow	70,71					*			*							OC HG PCB	
Jackdaw	72													*		OC	53
Black-capped Chickadee	73			*												OC OP	
White-breasted Nuthatch	66					*										OC HG	
Mockingbird	66			*												OC	
Catbird	67			*												OC OP	
Brown Thrasher	68									*						OC HG	
Robin	64-68,70,73,81			*	*	*					*		*			OC HG OP PCB	
Hermit Thrush	66			*												OC	
Swainson's Thrush	75,76			*												OP	
Gray-cheeked Thrush	64,66			*	*											OC HG	
Ruby-crowned Kinglet	74			*												OC OP	
Water Pipit	67,68,81,82				*								*			OC HG PCB	
Cedar Waxwing	64			*												OC	

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Northern Shrike	75					*										OC HG PCB	
Loggerhead Shrike	74,75					*										OC HG PCB	
Starling	63,67-70,72-75,77	*		*	*	*			*	*						OC HG PCB OP	16,43
Tennessee Warbler	64,66,74			*	*											OC OP	
Nashville Warbler	74,76			*												OC OP	
Parula Warbler	76			*												OP	
Yellow Warbler	74			*												OP OC	
Magnolia Warbler	64,71,72,74,75			*												OP OC	
Cape May Warbler	64,70,75			*												OP OC	
Myrtle Warbler	64,68,71,73,76			*	*								*			OP OC PCB	
Black-throated Green Warbler	72,74,76			*												HG OP	
Blackburnian Warbler	64,70,75,76			*												OC OP	
Chestnut-sided Warbler	73			*												OP	
Bay-breasted Warbler	64,70,72,74,76			*												OP OC	
Blackpoll Warbler	66,68,73,75,76			*									*			OP OC	
Ovenbird	64			*												OC	
Mourning Warbler	64			*												OC	
Yellowthroat	64,76			*												OC OP	
Wilson's Warbler	75			*												HG OP	
Canada Warbler	70,76			*												OC OP	
American Redstart	64,70,71,74-76			*	*											OC OP	
House Sparrow	68,70,71,82				*			*	*							OC HG PCB	26
Bobolink	64,81			*	*											OC HG PCB	
Western Meadowlark	68-71							*	*							OC HG	7,26
Red-winged Blackbird	68,70,71,73,81,82			*	*	*		*	*							OC HG OP PCB	7,26
Bullock's Oriole	64			*												OC	
Brewer's Blackbird	68-71,81							*	*							OC HG	7,26
Common Grackle	73,81				*	*										OC HG OP	
Brown-headed Cowbird	64,68			*					*							OC HG	7
Rose-breasted Grosbeak	64,73			*												OP	
Black-headed Grosbeak	66,73			*												OC	
Indigo Bunting	71								*							OC	
Evening Grosbeak	64,76			*												OC OP	
Purple Finch	64,71,73,74			*	*											OC OP	
Common Redpoll	66-68				*								*			OC HG PCB	
Pine Siskin	75			*												HG OP	

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Lark Bunting	68									*						OC	
Savannah Sparrow	64,67,67,71			*	*			*	*			*				OC HG	26
Sharp-tailed Sparrow	64			*												OC	
Vesper Sparrow	64,69-71,75			*				*	*							OC OP	7,26
Dark-eyed Junco	64,66,72,75,76			*												OC OP	
Tree Sparrow	64,66-68			*	*		*					*				OC HG	6
Chipping Sparrow	64,71,75			*					*							OC HG OP	26
Harris' Sparrow	66-68											*				OC HG	
White-crowned Sparrow	67				*		*									OC HG	6
White-throated Sparrow	64,66,67,70,75,78,79			*												OC OP	
Lincoln's Sparrow	75			*												OC OP	
Song Sparrow	64			*												OC	
McCown's Longspur	71							*								OC	26
Lapland Longspur	66-68,81				*							*				OC HG PCB	
Chestnut-collared Longspur	69-71							*	*							OC	7,26
Snow Bunting	67,82				*							*				OC HG PCB	
Masked Shrew	67-69			*												OC	
Water Shrew	69			*												OC	
Smoky Shrew	67,69,70			*												OC	
Short-tailed Shrew	67-69			*	*											OC HG	
Varying Hare	67,68,76			*									*			OC TE	
Eastern Chipmunk	67,68			*						*						OC	
Richardson's Ground Squirrel	68-71							*	*							OC HG PCB	7,26
Parry Ground Squirrel	68												*			OC	
Thirteen-lined Ground Squirrel	70,71							*	*							OC	26
Red Squirrel	67,68			*			*									OC PCB	6
Botta's Pocket Gopher	70									*						OC	
Beaver	68-71			*	*					*						OC HG	10
Deer Mouse	66-69			*	*			*								OC HG	7
Northern Grasshopper Mouse	68									*						HG	
Gapper's Red-backed Mouse	67-69			*												OC	
Meadow Vole	67-69			*	*		*									OC	
Muskrat	68,71,76,78			*	*	*	*									OC HG PB TE	45

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Southern Bog Lemming	68			*	*											OC	
Northern Bog Lemming	67				*											OC	
Varying Lemming	67,78						*						*			OC HG PB TE	6
Meadow Jumping Mouse	68,69			*	*											OC	
Woodland Jumping Mouse	67-69			*												OC	
Coyote	68,70,71									*						OC HG PCB	
Gray Wolf	71												*			OC PCB	
Red Fox	68,69			*						*						OC HG	10
Polar Bear	62,67-69,71-73,82				*	*	*				*	*		*		OC HG PCB PB TE	27,35,45
Raccoon	69			*												OC	
Marten	68			*												OC	
Fisher	68,69			*												OC	10
Ermine	68,69			*												OC PCB OP	10
Long-tailed Weasel	70									*						HG	
Mink	68-70,78,79,81-83			*		*				*						OC HG PB TE PCB	10
Badger	70,71									*						OC HG	
Lynx	71									*						OC	
Bobcat	68,69			*												OC	10
Ring Seal	67,70,72						*						*			OC PCB	27,35,38
Harp Seal	71				*											OC HG PCB	
Bearded Seal	71,72				*								*			OC HG PCB	27,35
White-tailed Deer	67-69			*												OC	10
Moose	66,71,72			*	*								*			OC HG PCB	
Caribou	67,68,72,78						*	*					*			OC PB TE PCB	
Dall's Sheep	72							*					*			OC HG PCB	
Smallmouth Salamander	76					*										OC HG PCB	
Redback Salamander	67			*												OC	
Green Frog	66,70			*												OC OP	
Pickerel Frog	73					*										HG PCB	
Wood Frog	70			*												OP	
American Toad	67,70,73			*	*											OC OP	
Woodhouse's Toad	74,76					*										OC HG PCB	
Northern Cricket Frog	74					*										OC HG PCB	
Spring Peeper	67			*												OC OP	
Pseudid Frog	71													*		OC HG PCB OP	34
Snapping Turtle	74-76,81					*										OC HG PCB	45
Painted Turtle	74					*										OC HG PCB	

SPECIES	YEARS	NFD	PEI	NS	NB	QUE	ONT	MAN	SAS	ALB	BC	YUK	NWT	USA	OTH	CHEMICALS	PUBLICATIONS
Spotted Turtle	74					*										OC HG PCB	
Blanding's Turtle	74,76					*										OC HG PCB	
Map Turtle	74					*										OC HG PCB	
Spiny Softshell	74					*										OC HG PCB	
Racer	75					*										OC HG PCB	
Ringneck Snake	76					*										OC PCB	
Fox Snake	75					*										OC HG PCB	
Milk Snake	76					*										OC HG PCB	
Northern Water Snake	74,76					*										OC HG PCB	
Queen Snake	76					*										OC HG PCB	
Brown Snake	76					*										OC PCB	
Eastern Ribbon Snake	76					*										OC PCB	
Common Garter Snake	68,75,76			*		*										OC HG PCB	
Massasauga	76					*										OC HG PCB	
Spectacled Caiman	71														*	OC HG PCB	34

APPENDIX C - Reference

A List of CWS Publications Which Make Use of Registry Data

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Charnetski, W.A. 1965. Chlorinated hydrocarbon residues in ducklings. Can. Wildl. Serv. Man. Rep. No. 1. 76 pp.

2
Gibbon, R.S. 1968. Residual DDT in relation to a population of Yellow-bellied Sapsuckers, Sphyrapius varius, in New Brunswick. Can. Wildl. Serv. Man. Rep. No. 9. 26 pp.

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Gilbert, F.F. 1969. Physiological effects of natural DDT residue and metabolites on ranch mink. J. Wildl. Manage. 33: 933-943.

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Berger, D.D., D.W. Anderson, J.D. Weaver, and R.W. Risebrough. 1970. Shell thinning in eggs of Ungava peregrines. Can. Field Nat. 84: 265-267.

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Brown, N.J. and A.W.A. Brown. 1970. Biological fate of DDT in a subarctic environment. J. Wildl. Manage. 34: 929-940.

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Fimreite, N., R.W. Fyfe, and J.A. Keith. 1970. Mercury contamination of prairie seed eaters and their avian predators. Can. Field Nat. 84: 269-276.

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Vermeer, K. and L.M. Reynolds. 1970. Organochlorine residues in aquatic birds in the Canadian prairie provinces. Can. Field Nat. 84: 117-130.

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Pearce, P.A. 1971. Side effects of forest spraying in New Brunswick. Trans. N. Am. Wildl. Nat. Resor. Conf. 36: 163-170.

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Pearce, P.A. and J.C. Baird. 1971. DDT closes New Brunswick Woodcock season. Can. Field-Nat. 85: 82.

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Reynolds, L.M. 1971. Pesticide residue analysis in the presence of polychlorobiphenyls (PCB's). Residue Rev. 34: 27-57.

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Vermeer, K. 1971. A survey of mercury residues in aquatic bird eggs in the Canadian prairie provinces. Trans. N. Am. Wildl. Nat. Resour. Conf. 36: 138-152.

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Vermeer, K. and J.A. Windsor. 1971. Spotted Sandpipers as possible indicators of mercury contamination of rivers. Blue Jay 29: 59-60.

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Postupalsky, S. 1971. Toxic chemicals and declining Bald Eagles and cormorants in Ontario. Can. Wildl. Serv. Man. Rep. No. 20. 45 pp.

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Keith, J.A. and L.M. Reynolds. 1971. Organochlorine pesticide residues in terrestrial and aquatic wildlife; mercury residues in wildlife. OECD Study 1967/68. Can. Wildl. Serv. Man. Rep. No. 21. 20 pp.

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Keith, J.A. and I.M. Gruchy. 1971. Residue levels of chemical pollutants in North American birdlife. Can. Wildl. Serv. Man. Rep. No. 22. 24 pp.

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Keith, J.A. and I.M. Gruchy. 1972. Residue levels of chemical pollutants in North American birdlife. In: Voous, K.H. ed. Proc. XV Int. Ornithol. Congress, The Hague, 30 Aug.-5 Sept. 1970. E.J. Brill Publishers, Leiden. pp 437-454.

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Dilworth, T.G., J.A. Keith, P.A. Pearce, and L.M. Reynolds. 1972. DDE and eggshell thickness in New Brunswick Woodcock. J. Wildl. Manage. 36: 1186-1193.

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Gilbertson, M. and L.M. Reynolds. 1972. Hexachlorobenzene (HCB) in the eggs of Common Terns in Hamilton Harbour, Ontario. Bull. Environ. Contam. Toxicol. 7: 371-373.

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Vermeer, K. 1972. The crayfish, Orconectes virilis, as an indicator of mercury contamination. Can. Field-Nat. 86: 123-125.

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Vermeer, K. and F.A.J. Armstrong. 1972. Mercury in Canadian prairie ducks. J. Wildl. Manage. 36: 179-192.

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Vermeer, K. and F.A.J. Armstrong. 1972. Correlation between mercury in wings and breast muscle in ducks. J. Wildl. Manage. 36: 1270-1273.

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Fyfe, R.W. 1973. Dieldrin and heptachlor epoxide in Alberta and Saskatchewan wildlife. Can. Wildl. Serv. Man. Rep. No. 27. 4 pp.

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Ryder, J.P. 1974. Organochlorine and mercury residues in gulls' eggs from western Ontario. Can. Field-Nat. 88: 349-353.

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Peakall, D.B. 1975. PCBs and their environmental effects. CRC Crit. Rev. Environ. Cont. 5: 469-509.

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Gilbertson, M., R.D. Morris, and R.A. Hunter. 1976. Abnormal chicks and PCB residue levels in eggs of colonial birds on the lower Great Lakes (1971-1973). Auk 93: 434-442.

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Fimreite, N. and L.M. Reynolds. 1973. Mercury contamination of fish in northwestern Ontario. J. Wildl. Manage. 37: 62-68.

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Fimreite, N. 1974. Mercury contamination of aquatic birds in northwestern Ontario. J. Wildl. Manage. 38: 120-131.

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Postupalsky, S. 1978. Toxic chemicals and cormorant populations in the Great Lakes. Can. Wildl. Serv. Man. Rep. No. 40. 25 pp.

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Peakall, D.B. 1980. Pollutant levels and their effects on raptoral and fish-eating birds. Proc. 17th Intern. Ornithol. Congress 2: 935-941.

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Mineau, P., D.V. Weseloh, and D.J. Hallett. 1979. Contamination par les substances organochlorees et reproduction du Goeland Argente, 1974-1978. Conference: Les contaminants dans l'environnement, Quebec.

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Appendix D

Preservation, Packaging and Shipment of Specimens for Contaminant Analyses or Storage in the CWS National Tissue Bank

TERMS

The following terms will assist you as you read these instructions:

Collector - the individual collecting the specimen.

Submittor - The CWS staff member responsible for submitting the specimen and responsible for ensuring that specimen collection, shipping methods and storage conditions prior to shipment are adequate.

Specimen - The individual of a species to be deposited in whole or in part in the tissue bank and/or analyzed for contaminants.

Tissue - The distinct parts of the specimen (e.g., liver, egg, feathers, skin, bone).

Sample - the contents of any individual storage container.

Specimen Preparation

1. Specimens or tissue to be analyzed for organic contaminants (organochlorines, herbicides, organophosphates, carbamates, etc.) should be stored in acetone and hexane rinsed glass jars with aluminum foil or teflon sheeting between the contents and the cardboard liner of the lid. Jars are especially suitable for egg contents, pieces of tissue and small whole specimens. Larger carcasses, shipped whole, should be wrapped, if practical, in aluminum foil sealed with masking tape and placed in leak proof linear-polyethylene bags. The container should prevent dehydration and/or contamination of the specimen. USE AN APPROPRIATE SIZE CONTAINER FOR YOUR SPECIMENS.

2. Specimens or tissues should, whenever possible, be shipped intact, i.e., whole carcasses or tissues. One exception to this is eggs which should always be processed prior to shipment such that the contents can be sent in glass jars and the shells in crush-proof containers. Measurements of the fresh weight (accuracy to 0.1g) of the egg, its length and width (accuracy to 1mm) should be taken prior to shipment. For large animals, a minimum of 100g and maximum of 500g of a tissue is desirable, as is the standardization of the segment of the tissue which is collected.
3. Specimens or tissue to be analyzed for heavy metals should be shipped in linear-polythylene bags, i.e., Whirl-Paks, or linear-polyethylene vials or jars with polyethylene lids. Contact us for specific instructions on the cleaning of polyethylene vials, jars and lids prior to use.
4. NEVER ship specimens, including whole eggs, in paper, cardboard, styrofoam cartons or plastic. (See #2 above).

Preservation of Specimens

The preferred method of preservation is freezing as soon as possible after collection. If this is not possible, specimens can be preserved in alcohol or formalin. Specimens stored in alcohol or formalin should contain the following additional information:

1. Weight of the specimen before preservative is added.
2. Volume of preservative used for each specimen shipped.

Approximately 200ml of the preservative used should be shipped in a container identical to those used for the specimens. This will serve as a check on the background levels of contaminants in the preservative and the jars.

Collection Data

1. COMPLETE collection data for each specimen or tissue must be written out on a CWS Collection Form (See attached form). If Collection Forms are unavailable data may be included in a covering letter. Complete collection data would include, whenever possible: specimen number (assigned by collector or submittor); genus, species, common name, sex and age of specimen; location and date of collection; condition of specimen at the time of collection and any other pertinent information the collector or submittor wishes to provide. SPECIMENS WITHOUT COMPLETE DATA WILL NOT BE ANALYZED.
2. SEND ONE COPY OF THE COLLECTION FORM (or covering letter) to us in Ottawa (Wildlife Toxicology & Surveys Branch) and keep the original on your file. It is impossible to copy data off labels attached to specimens particularly when specimens may sometimes be sent directly to contracting laboratories.

Specimen Labelling

1. Every specimen must be labelled with a specimen number, assigned by the collector or submittor, so that it can be matched with the itemized Collection Forms. Where a group of tissues has been given one specimen number, individual tissues within the group should be differentiated by labelling them with an additional numerical identifier. SPECIMENS WITHOUT PROPER IDENTIFICATION WILL NOT BE ANALYZED, AND WILL BE DISCARDED.

2. Labels should be affixed to the container rather than the lid and should be waterproof and freezer proof. Intact carcasses in plastic bags should have tags attached directly to the carcass and labels on the plastic bags. Do not place a label inside a container in contact with a tissue.

Packaging of Specimens for Shipment

1. For frozen specimens use a polystyrene ice chest (cheap molded kind found in most hardware stores is adequate). Place the frozen wrapped specimens or tissue containers in the centre of the ice chest, surround them with wrapped dry ice slabs or freezer-packs and surround everything in more newspaper or other insulating and padding material. Ensure all air spaces are filled with loosely crumpled paper or other material to reduce convection. Seal the ice chest carefully with tape. Do not tie ice chest with string or otherwise mask the appearance of the chest.
2. For specimens preserved in liquid, cardboard or wooden boxes are better than ice chests. Use plenty of packing material to avoid any beakage and ensure none of the containers leaks. (Shipping companies frown on the odors and possible damaging effects of perservatives). You must also meet the requirement of the Transport of Dangerous Goods Act. Wrap and seal each jar in its own plastic bag. This will help contain liquids if the jar is broken.
3. Each shipment must be accompanied by:
   (a) A covering letter which indicates the collector and/or submittor for the specimens and reasons for shipment, i.e., for analysis, for National Tissue Bank, etc.

3. b) one copy of the CWS Collection Form or suitable replacement (see above).

c) copies of permits and customs documents as required for international transport.

d) documentation and labelling to meet Transport Canada regulations.

Method of Shipment

1. The best method of shipment is by AIR EXPRESS. This ensures prompt delivery on the first available flight. Shipments should be on the most direct flights.
2. Ship specimens early in the week and preferably in the evening. This allows the receiver a full working day to pick up or trace shipments. NEVER SHIP SPECIMENS ON FRIDAYS OR SATURDAYS.
3. THE SUBMITTOR SHOULD CONTACT THE RECEIVER BEFORE SHIPPING TO ENSURE THAT SOMEONE IS AVAILABLE TO PICK UP THE SPECIMENS AT THE AIRPORT UPON ARRIVAL. When the submittor receives the information on which flight the specimens will depart and their waybill number he should immediately contact the receiver.

Shipping Labels

1. All packages should be clearly labelled. The carrier's labels should be marked to indicate the contents such as FRAGILE, FROZEN, PERISHABLE, GLASS, etc.
2. All waybills and parcels should have on the label "HOLD AT AIRPORT FOR PICK UP" and the telephone number of the receiver.

3. All packages should be sent to the Ottawa office unless prior arrangements have been made. The shipping label should be addressed as follows:

Wildlife Toxicology & Surveys Branch
Canadian Wildlife Service
Environment Canada
National Wildlife Research Centre
Ottawa, Ontario
K1A OE7

ATTENTION: Mr. W.J. Learning

HOLD AT AIRPORT FOR PICK UP
TELEPHONE (819) 997-1410

4. If arrangements have been made with Mr. W.J. Learning or Ms. Patricia Angehrn in his absence to ship directly to the contracting laboratory prepare shipping labels as shown below and contact the individual listed prior to shipment.

Dr. L.M. Reynolds
Department of Applied Chemistry
Ontario Research Foundation
Sheridan Park
Mississauga, Ontario

HOLD FOR PICK UP AT AIRPORT
TELEPHONE (416) 675-3870

Mr. A. Lipsky
Barringer Magenta Limited
304 Carlingview Drive
Metropolitan Toronto
Rexdale, Ontario
M9W 5G2

HOLD FOR PICK UP AT AIRPORT
TELEPHONE (416) 675-3870

5. When shipping specimens across international borders the Convention on International Trade in Endangered Species, and appropriate Customs Acts must be taken into consideration. Canada Department of Agriculture may also wish to become involved. If in doubt about permits and forms consult the Canadian Wildlife Service, Trade in Endangered Species Section in Ottawa, well in advance of any shipments. Export permits from the country of shipping and import permits will probably be required and often are issued only after lengthy applications and periods of approval. Other contact persons are:

a) Dr. A.E. Lewis or Dr. Bonin
Import and Export Section
Contagious Diseases Division
Canada Department of Agriculture
Sir William Logan Building
Ottawa, Ontario

Telephone: (613) 995-5433

b) Dr. G.P. Pierson
Chief Staff Veternarian
Imported Birds and Poultry
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
Federal Building
Hyattsville, Md. 20782

Telephone: (202) 436-8383

c) Mr. Larry LaRochelle
Director
USFWS Permit Office
Washington, D.C. 20240
U.S.A.

Telephone: (202) 634-1496